N. Y. (STATE), COMMISSION FOR THE BLIND.
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TO GENERAL DISEASE.

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JULY 1949

Prevention of Blindness Service

New York State COMMISSION FOR THE BLIND
STATE DEPARTMENT OF SOCIAL WELFARE

205 East 42nd Street
New York 17, New York

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It has been long recognized that the state of health of the body as a whole has a definite effect on the health of the eyes. The following pages have been prepared in an attempt to clarify the relationship between general diseases and eye diseases for the reader who has no specialized knowledge in the field of ophthalmology.

In man and the higher animals the eye represents an expanded and specialized portion of the brain. Therefore, certain diseases of the brain can often be recognized through a study of the eyes. The eye is also the one place in the body where blood vessels are not covered by opaque tissues; not only are they exposed to direct view, but they may be observed under a magnification of approximately 15 times their natural size. Since many diseases affect all the blood vessels of the body to nearly an equal degree, a study of the blood vessels of the eye often permits an early diagnosis of such diseases as arteriosclerosis (hardening of the arteries), hypertension (high blood pressure), nephritis (kidney disease), diabetes (excess of sugar in the blood), and the group of blood diseases named the leukemias, which are characterized by the presence in the blood of an excessive number of white blood corpuscles.

Gross Anatomy of the Eye (Figs. 1 and 2)

A knowledge of the anatomy and embryology of the eye is vital to an understanding of the eye in relation to general diseases. A brief discussion follows of the structures which compose the eyeball and are closely associated with it: the cornea, the three coats of the eyeball, the optic nerve, the crystalline lens, the vitreous and aqueous humor, the eyelids, the conjunctiva or modified skin lining the eyelids, the lacrimal apparatus which produces and drains the tears, and the extraocular muscles.

* Aided by a grant from The Ophthalmological Foundation, Inc.

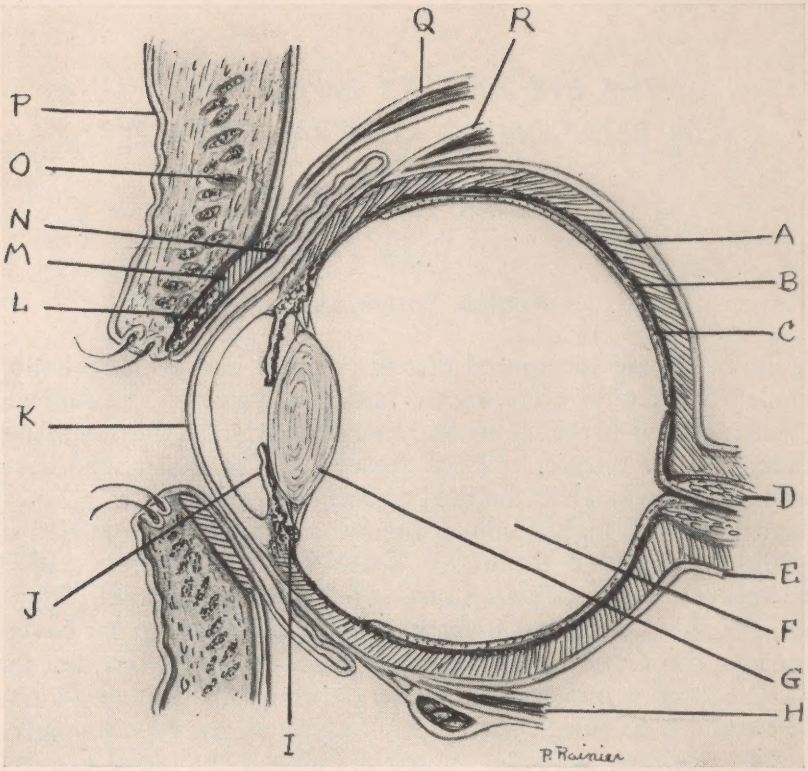


FIG. 1 – Sagittal Section through the Eyeball and Eyelids.
A – sclera; B – choroid; C – retina; D – optic nerve; E – sheath of optic nerve; F – vitreous; G – lens; H – inferior rectus; I – ciliary body; J – iris; K – cornea; L – Meibomian gland; M – tarsus; N – conjunctiva; O – orbicularia muscle; P – skin of the eyelid; Q – levator palpebrae superioris; R – superior rectus muscle.

The *cornea* (window of the eye) is the curved, transparent, tough membrane which constitutes the front of the eyeball. It allows the light to pass through, but protects the contents.

The *sclera*, commonly called the white of the eye, forms the protective outer coat of the eyeball, and affords attachment for the external muscles which make it possible for the eye to turn in the various directions.

The *vascular or second coat* of the eye (uveal tract) is the layer which lies directly beneath the sclera. It contains the blood vessels that nourish the interior of the eye. This layer consists of three distinct parts which differ structurally from one another. They are:

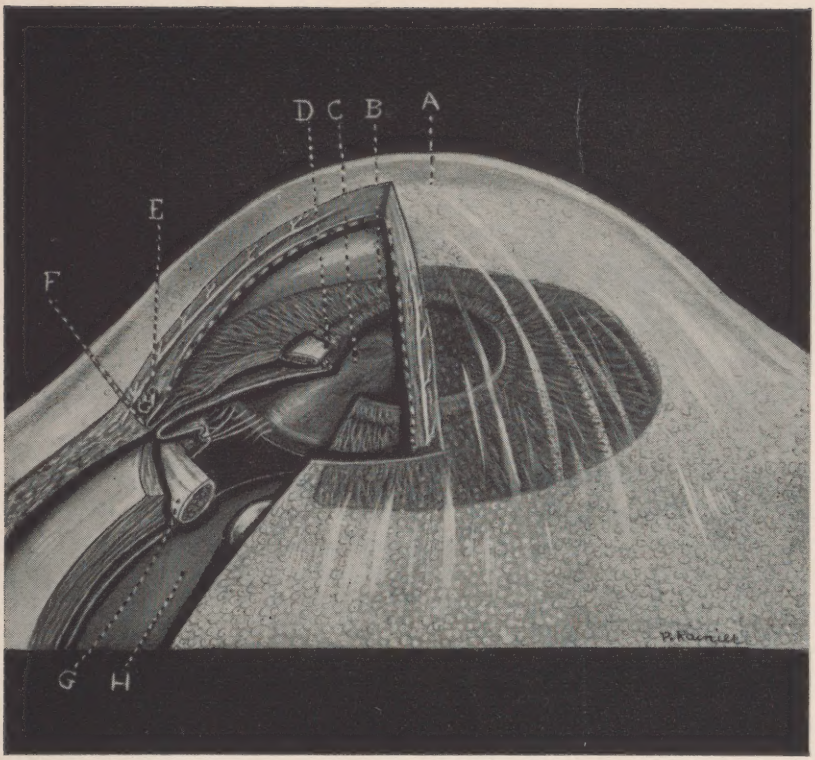


FIG. 2 – Greatly magnified section of the front portion of the eye ball: A – cornea; B – iris; C – lens; D – sphincter muscle of the iris, which causes the pupil to contract; E – Schlemm's canal; F – angle of the anterior chamber; G – ciliary muscle; H – vitreous.

the iris, the bulk of the ciliary body and the choroid. The *iris*, which is formed of the blood vessel layer and a background of pigmented cells, encloses a round opening which is the *pupil*. The color of the iris varies in different individuals from blue to gray and brown. The pupil is situated at the center of the iris for the transmission of light. The *ciliary body* (Fig. 2) contains the muscles which make it possible for the eye to focus. The *choroid* lines the greater part of the eyeball and serves as a source of nourishment for the rods and cones of the retina.

The *retina*, or nerve coat, is the innermost coat of the eye. Its function is to receive the light rays, which produce an inverted image of the observed object. This image is then carried by the optic nerve to the brain, where it is turned right side up and interpreted.

The *optic nerve* is a relatively thick stem which connects the eye with the brain. It is composed of many individual nerves, each one covered by a sheath and all of them bound together by strong connective tissue fibers. The optic nerve itself is surrounded by three sheaths, which are continuous with the sheaths of the brain.

The *crystalline lens* is the transparent structure behind the pupil which focuses light rays on the retina. It corresponds to, and has practically the same shape as, the lens in the camera. The crystalline lens has no blood vessels, but is nourished by the fluids (vitreous and aqueous humor) surrounding it. It is made up of many concentrically arranged cells and the lens grows continually throughout life by the lengthening of these cells.

The *vitreous* is a substance resembling the white of an egg, which fills the space back of the lens and maintains the shape of the eye. If its nutrition is disturbed or chronic infection attacks the blood vessel coat of the eye, the vitreous becomes cloudy and the patient is aware of floating spots or strands. Under these circumstances the vitreous may also lose its gelatinous consistency, becoming fluid.

The *aqueous humor* is the watery liquid that fills the front portion of the eyeball between the cornea and the lens. It is secreted by the ciliary body behind the iris. The aqueous humor passes through the pupil and leaves the eye in front of the iris, through the angle between the iris and the cornea where it is drained off through the canal of Schlemm and the aqueous veins. Interference with its circulation gives rise to increased hardness of the eyeball, a condition known as glaucoma.

The *eyelids* are composed of several layers of tissue. Beneath the outer skin is the muscle that opens and closes the eyelid. This muscle overlies the tarsus, which is a plate of dense fibrous tissue that gives the eyelid its shape. The *tarsus* contains the meibomian or grease glands, and provides an attachment to the muscles which move the eyelids.

The *conjunctiva* is the modified skin that lines the inside of the eyelids and extends over the anterior one-third of the eyeball. It is composed of an outer layer of epithelial cells which differ from the epithelial cells of the skin because they do not have a horny substance.

The *lacrimal apparatus* is a system of glands and ducts concerned with the circulation of tear fluid. The lacrimal gland, which produces the tears, is situated beneath the outer portion of the eyebrow. Its

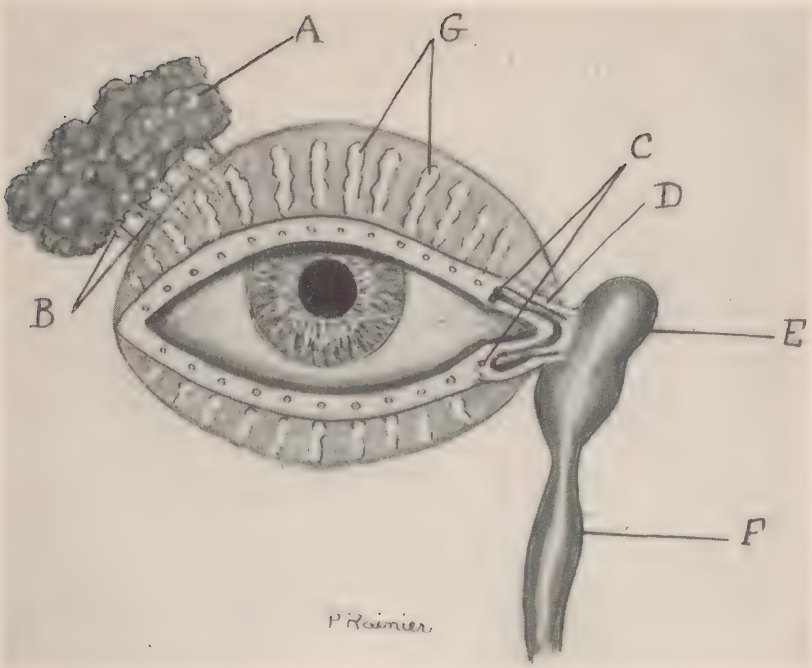


FIG. 3 – The Lacrimal Apparatus: A – lacrimal gland; B – ducts of the lacrimal gland; C – puncta (upper and lower); D – canaliculus; E – lacrimal sac; F – nasolacrimal duct; G – Meibomian glands contained within the tarsal plate.

delicate ducts empty into the upper fornix, or fold of the conjunctiva. After having discharged its functions of lubricating and cleansing the surface of the cornea, the tear fluid is drained off through the puncta, or small holes, one being located near the nasal corner of each eyelid. From here, the tears pass through narrow ducts (canaliculi) to the lacrimal sac, which carry them to the nasolacrimal duct and finally into the nasal cavity. This system of canals accounts for the fact that medicine instilled in the eye is often recovered in the nose and throat.

The *muscles* which turn the eyeball are six in number, four recti or straight muscles and two oblique muscles. The four recti muscles (Fig. 4) are: (A) the medial rectus muscle, which turns the eyeball toward the nose; (B) the inferior rectus muscle, which turns the eyeball downward; (C) the lateral rectus, which turns the eyeball toward the temple; and (D) the superior rectus, which turns the eyeball upward. The two oblique muscles are: (E) the superior oblique, which, from the primary position, turns the eyeball downward and outward but rotates the eyeball downward when the eye is turned

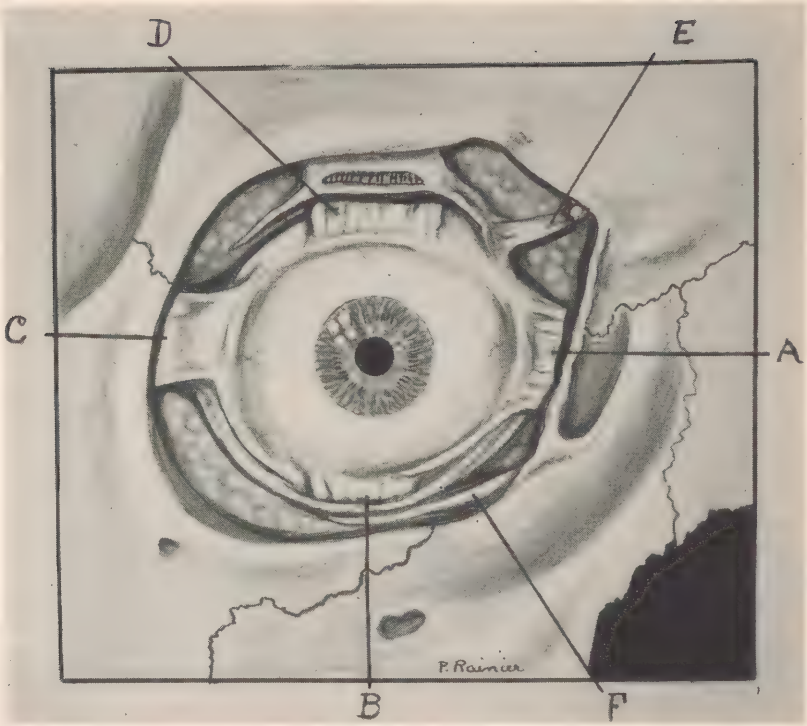


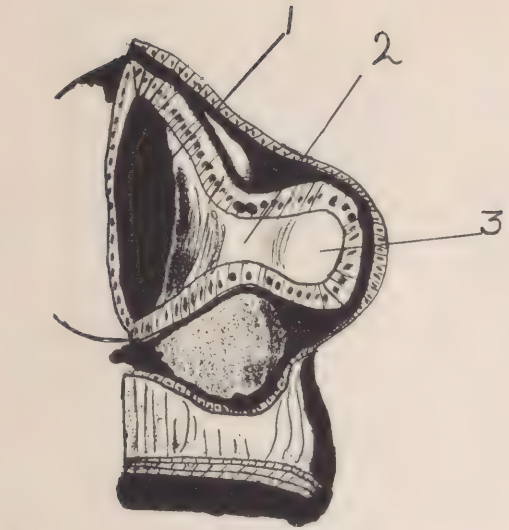
Fig. 4 – Extraocular Muscles. A – medial rectus muscle; B – inferior rectus muscle; C – lateral rectus muscle; D – superior rectus muscle; E – superior oblique muscle; F – inferior oblique muscle.

inward; and (F) the inferior oblique muscle, which, from the primary position, turns the eyeball upward and outward but rotates the eyeball upward when the eye is turned nasally.

Embryologic Development of the Eye

The eyeball develops from an out-pouching of the brain which projects forward on either side of the head to form the primary optic vesicle (Fig. 5A). This pouch or vesicle consists of a thin layer of tissue from which the retina develops.

In shape, the young human embryo resembles a little tadpole (Fig. 5B). On the back of this embryo a groove develops by the infolding of the outer layer or primitive skin. This groove is called the neural groove because it gives rise to the nervous system. The edges of the neural groove unite, thus forming the neural canal. This closure begins



A

B

FIG. 5A — Forebrain and optic vesicle on one side of embryo, shown in section. 1 — forebrain; 2 — optic stalk (later the optic nerve); 3 — primary optic vesicle (later the eyeball). (After Mann.)

FIG. 5B — Superficial view of young human embryo; 1 — neural groove; 2 — neural canal; 3 — primitive brain; 4 — optic pit. (After Mann.)

in the middle of the embryo and progresses forward and backward. The open front portion of the neural groove meanwhile commences to form little pouches, separated by indentations, thus marking off the divisions of the brain. In one of these pouches there appears on each side a depression, the optic pit (Fig. 6A), which grows out to form a grape-like vesicle, the primary optic vesicle (Fig. 6B). From this vesicle the eyeball is formed. The vesicle remains attached to the brain by means of a stalk which becomes the optic nerve. The optic vesicle comes into close contact with the layer of primitive skin. At this point a thickening forms in the skin; this is the lens plaque. This plaque pushes the optic vesicle in and becomes the lens groove, which, by detaching itself from the rest of the skin, becomes the lens vesicle. The lens vesicle becomes filled with cells and fibers and eventually develops into the lens of the eye. The optic cup now has two layers; the inner layer forms the visual or seeing portion of the retina, while the outer layer acquires pigment (layer of pigmented epithelium) and serves as a light-proof background for the retina. From the inner layer of the retina, fibers grow toward the optic stalk and thence to the brain. This bundle of nerve fibers is known as

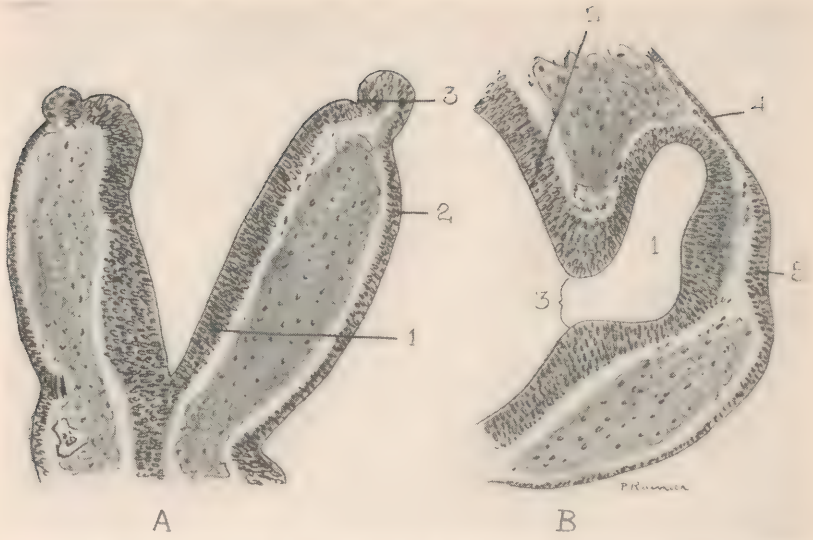


Fig. 6A – Section through front portion of human embryo: 1 – neural groove; 2 – primitive skin; 3 – optic pit. (After Salzmann.)

Fig. 6B – Sagittal section through primary optic vesicle: 1 – primary optic vesicle; 2 – cavity of primitive brain; 3 – optic stalk; 4 – primitive skin; 5 – lens plaque showing transition to lens groove. (After Salzmann.)

the optic nerve. These stages in the development of the eye are diagrammatically represented in figure 7.

Surrounding the optic cup is a mass of tissue which condenses to form the tough outer coat of the eye (the sclera), the front part of which remains transparent to form the cornea or the window of the eye. Other portions of this tissue differentiate to form the iris (the

Fig. 7 – Diagrammatic representation of the development of the primitive human eye: 1 – cavity of forebrain; 2 – cavity of optic vesicle; 3 – cavity of optic vesicle becoming obliterated by formation of optic cup; 4 – optic cup well formed; 5 – two layers of optic cup; 6 – optic stalk; 7 – optic nerve developing. (After Mann.)

diaphragm of the eye) enclosing a round opening, the pupil, and the ciliary body with its muscle which acts on the lens to make it focus the image sharply on the retina.

The under surface of the optic cup remains open forming a groove. Through this groove two blood vessels, a vein and an artery enter the optic cup just before the groove closes. These vessels form the central vein and artery of the retina (see Fig. 12).

Anatomical Relation of the Eye and Body

We have seen from the discussion on embryology of the eye that there is an intimate relation between the eye and the brain. However, we must also be aware of the fact that the eye as a part of the body is

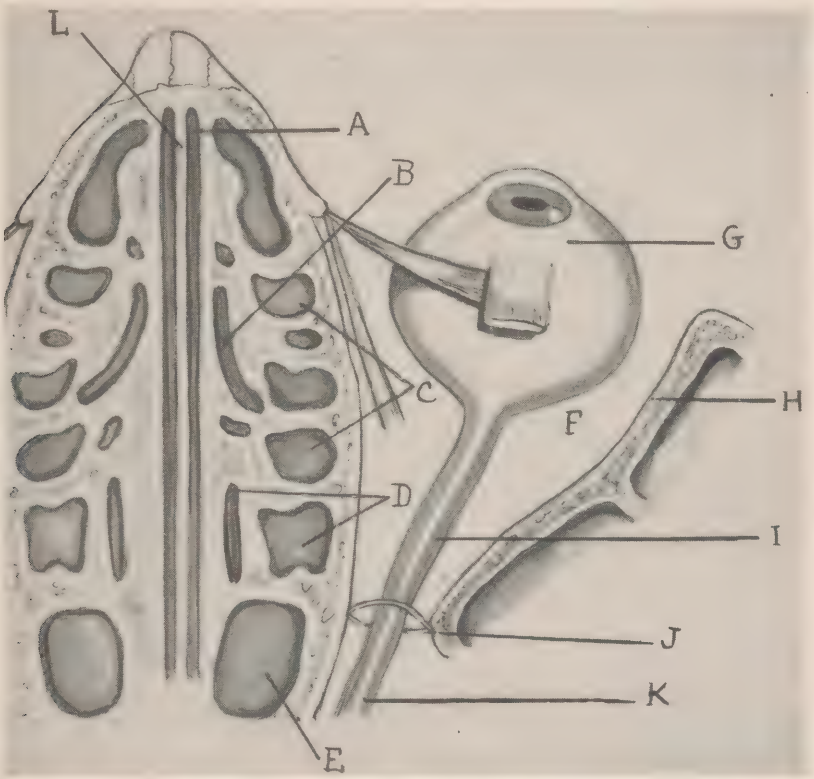


Fig. 8 – Schematic drawing of a horizontal section through the right orbit to illustrate the relation of the nasal sinuses to the eye. A – nasal cavity; B – ethmoid cell; C – anterior ethmoid cells; D – posterior ethmoid cells; E – sphenoid sinus; F – orbit; G – eyeball; H – lateral wall of the orbit; I – optic nerve; J – optic foramen; K – intracranial portion of optic nerve; L – nasal septum.

connected with the general blood vessel system and with the lymphatic system which includes glands, vessels, sinuses, and spaces as well as serous membranes.

The most intimate association that the eye has with the body is in relation to the sinuses of the nose (see Fig. 8). On both sides of the nasal septum (the tissue dividing the nose into two cavities), the turbinate bones protrude like flaps into the nasal cavities from the inner walls of the orbits. In the wall of the orbit are the ethmoid cells, consisting of an anterior and a posterior group on each side. Behind them is the sphenoid sinus, closely adjoining the optic nerve. It is easy to understand that an inflammation of the sphenoid sinus may cause an inflammation of that portion of the optic nerve which is situated behind the eyeball.

The close connection that exists between the eye and the sinuses through the many veins and lymphatic vessels (the latter carry colorless fluid and white blood cells) makes it possible for any part of the eyeball to be involved when there is an inflammation of the nasal passages or sinuses.

EYE SYMPTOMS SUGGESTIVE OF GENERAL DISEASES

Let us now consider the symptoms which lead us to suspect an abnormal condition of the eye, and also attempt to deduce any relationship which may exist between eye symptoms and general symptoms.

(1) *Eyestrain and Headache.* A majority of the people suffering from headache attribute it to eyestrain and the first step usually is to consult an eye physician. Although headache may arise from various diseases, the oculist should always endeavor to exclude the eye as a factor because it is a dangerous practice to diagnose the cause of a headache from its location and character alone.

What is an eye headache? There is no typical eye headache but the following characteristics should lead one to consider the eyes as the probable cause of the headache: a headache which is brought on or aggravated by the use of the eyes; a headache located over the eyes, or around the eyes, or sometimes radiating down the back of the neck. However, even in apparently typical cases, we must not overlook the fact that other conditions may cause the headache. The time of occurrence is an important factor. If the patient awakens in the morning with headache around the eyes, or above the eyes, and feels better after being up for a while, the headache may be caused by infection of the nasal sinuses.

A headache which radiates down the back of the neck is often attributable to faulty coordination of the eye muscles. If it is difficult for the patient to focus his eyes for a long time on close objects, the condition is called weakness of convergence or convergence insufficiency. This is a common finding and one of the most frequent causes of difficulty in using the eyes. This condition is often observed in children who return to school having had no occasion for using their eyes for close work all summer. It is due to rapid fatigue or weakness of the coordinating centers of the ocular muscles.

Headaches may also arise from a systemic infection, viz., infection in the sinuses or intestinal tract, or from excessive mental strain. If headache persists for a long time, other causes, such as migraine, and increased pressure in the brain following a brain tumor or a head injury, should be ruled out.

(2) *Photophobia.* We see many children who complain of fear of the light. What is the significance of this symptom? Photophobia may be caused by inflammation of the iris or cornea, or it may be due to irritation of the conjunctiva (the membrane lining the eyelids), or to inflammation along the borders of the eyelids. Photophobia may even signify the need of proper eye glasses, for the excessive use of the muscles of the eye entails a great strain which gives rise to congestion and irritation which in turn produces photophobia. But fear of light is also commonly due to causes remote from the eyes, namely, general infection or focal infection. The focus may be situated in the teeth, tonsils, sinuses, intestines, and other parts of the body.

(3) *Lacrimation.* Tearing is common and may arise from a simple local condition such as narrow, malplaced or blocked drainage channels from the eye, but quite often this is not the case. Among causes outside the eye is nervous stimulation of the tear gland. Since tearing may be associated with chronic nasal infection, anyone who is constantly troubled with tearing should have his nose and sinuses examined. In infants tearing may indicate that the tear passages into the nose have failed to open. This condition is often cured by passing a probe through the tear duct.

(4) *Diplopia.* Double vision may be monocular or binocular, depending upon whether the patient sees double when using one eye alone, or only when using both eyes together. The latter is the type in which we are most interested as it is sometimes due to serious disease. Temporary attacks of double vision, occasionally encountered in school children, may be due to hysteria or to transient disorders of

the eye muscles. However, too often double vision indicates disease of the brain (for example, brain tumor, epidemic encephalitis, meningitis and syphilis) or, in older people, disease of the arteries (arteriosclerosis).

(5) *Congestion of the borders of the eyelids.* This is a common complaint. It may be due to local causes, but frequently it is associated with other infections, especially with sinusitis and infection of the scalp.

(6) *Failing Distant Vision.* If this symptom is present in a young person attending school, it is probably due to the fact that he is becoming slightly near-sighted. Near-sightedness can be corrected by wearing appropriate eyeglasses. If distant vision fails in the adult, it is commonly due to the fact that he is unable to compensate for a far-sighted condition (hyperopia) because of an increasing loss in the elasticity of the lens (presbyopia). However, cataract (clouding of the lens), glaucoma (hardening of the eyeball), and other chronic diseases of the eye should also be considered as possible causes.

Poisoning by tobacco, alcohol and arsenic may cause neuritis of the nerve back of the eyeball (retrobulbar neuritis) resulting in disturbance of vision. Diabetes and nephritis may disturb vision as the result of changes in the retina (diabetic and renal retinopathy).

(7) *Failing Near Vision.* In the adult the vision for near normally begins to fail after the age of about 45 years. This is due to loss of elasticity of the lens. The same symptom in a child often indicates that he is commencing to be troubled by far-sightedness (hyperopia). These patients are benefited by properly fitted glasses. Sometimes failing near vision may signalize a more serious condition. It may mean the early stage of sympathetic ophthalmia (inflammation of a healthy eye due to injury of the other) or it may be an early sign of glaucoma. Weakness of accommodation due to diphtheria, anemia, hypothyroidism and syphilis may cause difficulty in reading or other near work.

(8) *Halos.* Seeing colored rings or halos around lights is a common sign in glaucoma. It may also be due to inflammation of the cornea, or to an early stage of cataract, or even to toxic conditions.

(9) *Nyctalopia.* Night blindness is sometimes due to a dietary deficiency, that is, insufficient vitamins in the diet. At other times it is the chief symptom of a disease known as retinitis pigmentosa which may be hereditary or result from syphilis (syphilitic chorio-retinitis).

(10) *Micropsia and Macropsia.* Micropsia is seeing things smaller than they are and macropsia means seeing things larger than they are. In the exact center of the seeing layer of the retina in the back of the eye there is a spot where vision is most acute – the yellow spot or macula lutea. The apparent size of an object depends upon the number of seeing elements in the retina upon which the image of this object falls. If the yellow spot becomes swollen, fewer elements are stimulated and the object appears smaller. If there is a depression in this region, more elements are exposed and the object appears larger. This is a very ominous sign because any disease of the macula lutea is serious and, if possible, an attempt should be made to find the cause.

Certain Diseases of the Eye Associated with General Diseases

It is important to realize that many disturbances of the eye may be the result of serious general disease. Moreover, an eye symptom should not be neglected and when in doubt an oculist should be consulted.

Herpes Zoster Ophthalmicus. Herpes Zoster or shingles is a disease of the sensory nerve. It may affect any nerve. It becomes of interest to the eye physician when it affects the ophthalmic division of the fifth nerve which goes to the eye. Clinically, the disease consists of blisters surrounded by an area of inflammation. The most striking feature of this affection is the severe pain which usually precedes the appearance of the blisters. The blisters break, leaving permanently depressed scars. This disease is due to a filterable virus (an organism which is too small to be seen with the microscope and which passes through a bacterial filter). Since the infection must have a portal of entry into the body, we should investigate more carefully the sinuses which many observers consider of prime importance in this infection. The treatment of shingles is largely palliative, consisting of ointments and lotions.

Convergent Squint or Crossed Eyes. As soon as a child is known to have squint, he should be examined by an eye physician. If the child uses only one eye, he is using only about one-half of his brain. Using both eyes together he develops both sides of his brain. If one eye is used to the exclusion of the other the vision fails in the unused eye.

Squint may be caused by a serious disease of the brain, the eye, the nervous system, or the nerves of the eye, and a diagnosis can be made only after a thorough examination. A popular belief, which has been shown to be erroneous, is that a child cannot wear glasses until the age

of three or four years. Glasses can be worn by children a year old or even younger.

Another fallacy is the belief that these children cannot be operated upon until they are 13 or 14 years old. One should consider the psychologic handicap under which these children labor if operation is delayed until they are "teen-agers." This is only one of the reasons why we should operate early (e.g., at three to four years of age). But probably the most important reason lies in the fact that if the eye doctor succeeds in straightening the eyes at an early age by exercise, glasses or operation, both sides of the brain are permitted to develop simultaneously.

Divergent Squint or Wall Eye. This type of squint, in which the eyes turn outward, is less common than crossed eyes and may at times be corrected by properly adjusted glasses for myopia (near-sightedness). One should always search for other possible underlying causes, such as malnutrition, disease of the brain, of the deeper parts of the eye, or of the other skeletal muscles of the body. When it becomes apparent that non-operative measures will not suffice, operation should not be delayed.

Chalazion. A chalazion is a tumor or lump in the eyelid due to an infection of one of the Meibomian glands. Here, too, other causes outside the eye are sometimes responsible. Recurring multiple chalazia with chronically inflamed eyelids are frequently associated with an infection in the nose. If the cause can be removed, the treatment is facilitated. Because it is an inflammatory swelling it will sometimes subside spontaneously. If it is painful, it should be opened and treated like an abscess in any other location. Occasionally eye drops instilled into the eye will aid in the medical cure by opening the ducts and permitting the retained secretion to be discharged. It is also important to treat the other Meibomian glands, for enlargement of one gland usually means that many other glands are involved. Therefore, the eyelids should be treated regularly in order to prevent a recurrence of this condition.

Dacryocystitis (inflammation of the tear sac). If we recall the anatomy of the lacrimal apparatus, we know that the tears are drained through the tear sac and the tear duct into the nose. Along its entire course this duct is in close relation to the sinuses. It is for this reason that tearing often accompanies sinus infections. The tearing is produced by a diminished outflow due to the constriction of the tear duct combined with an increased secretion caused by an irritation of the

nerves which supply both the sinuses and the tear glands. Therefore in most of these cases the underlying causes must be treated. The condition may sometimes be relieved by passing a probe down through the tear duct, but this form of treatment should be used only as a last resort, since probing may cause an injury to the lining membrane of the duct and thus give rise to a much more serious condition than the original one.

Phlyctenular Keratoconjunctivitis (pimples and ulcers on the cornea and conjunctiva). This condition is characterized by an inflammation of the conjunctiva (the lining membrane of the eyelids) and of the cornea. Its cause has not been definitely determined. It is often associated with marked eczema of the scalp. The eye lesions consist of little pimples on the conjunctiva and cornea, and most characteristically at the border between the conjunctiva and cornea. Children affected by this disease often suffer also from chronic nasal catarrh. For this reason and others, certain oculists are beginning to attribute it to chronic infections in the nose. From experiments on animals certain workers have been led to attribute this disease to other factors, such as an excess of sugar in the diet and other dietary faults. In many instances it is caused by tuberculosis, but the essential point is not to overlook any of the possible factors.

Gonorrheal Conjunctivitis in the Newborn. This disease is also known as ophthalmia neonatorum. This name, however, is misleading, for all ophthalmia (that is, inflammation of the eye) in the newborn is not due to gonococci. It is true that the gonorrheal variety is the one which usually leads to the most serious consequences, but many cases are caused by one or the other of the numerous ordinary bacteria. Fortunately, through the work of the National Society for the Prevention of Blindness and other similar societies and organizations throughout the world, ophthalmia neonatorum has been successfully controlled.

Interstitial Keratitis. This is an inflammation of the cornea, usually due to congenital syphilis. It may begin in one eye, but sooner or later involves the other as well, regardless of the type of treatment employed. In fact it has been noted that during the course of active treatment with arsenicals, when only one eye was affected, the disease would appear in the other healthy eye. The introduction of penicillin and similar antibiotics, may offer a better chance for the control of this condition. It is encouraging to know that no matter how serious the disease may appear to be in its acute stage, it can usually be ameliorated, and very frequently practically normal vision may be restored.

It is essential to the proper understanding of this condition to bear in mind that the patient with interstitial keratitis may also have a dental infection, or intestinal trouble, which may act as a contributing cause.

Scleritis. This is an inflammation of the sclera (the tough outer coat of the eyeball) and is characterized by a nodule in the sclera. It may be situated superficially, in the episclera, in which case the inflammation is called episcleritis. If it is located more deeply, it is diagnosed as a true deep scleritis. Some believe that this disease is always due to tuberculosis. We are convinced that it may be due to syphilis, and that it may also be due to other chronic infections, the so-called focal infections. If this condition is permitted to progress without proper treatment the whole eyeball may become involved and be permanently damaged.

Iritis (inflammation of the iris). The usual symptoms of iritis are pain in the eye, fear of light, tearing and dimness of vision. The inflamed iris appears dull and of a somewhat different color than its normal mate; the pupil is contracted and irregular, and there is redness of the conjunctiva, especially in the region surrounding the cornea. When examined carefully through a magnifying glass, the iris shows markedly congested blood vessels.

The end result of an inflammation of the iris is shown in figure 9A. The lens or magnifying glass of the eye becomes opaque; the iris is bound down to the lens and hardening of the eyeball or glaucoma results. Sometimes the pupil is covered by a membrane so thick that it causes blindness and has to be cut in order to enable the patient to see.

Among the causes of iritis, tuberculosis ranks quite high. However, it has occurred in association with syphilis, rheumatism, gonorrhea, diabetes, dental infection, nasal disease and many other general infections.

The early recognition of iritis is important and the patient should be kept under careful observation and treatment for a long period of time. Treatment consists chiefly in attempting to dilate the pupil and keeping it dilated with atropine (belladonna). As the pupil dilates we may notice (Fig. 9B) that portions of the tissue of the iris are still adherent to the anterior surface of the lens. The adhesions, when fresh, are usually broken up by simple treatment. If they fail to break, new adhesions form with repeated inflammations, until the entire border of the iris becomes bound down to the lens, and the pupil is often covered by a membrane. Thus, the end result of an untreated iritis may be a blind eye which might have been saved by early and proper treatment. It is important to realize that an inflammation surrounding

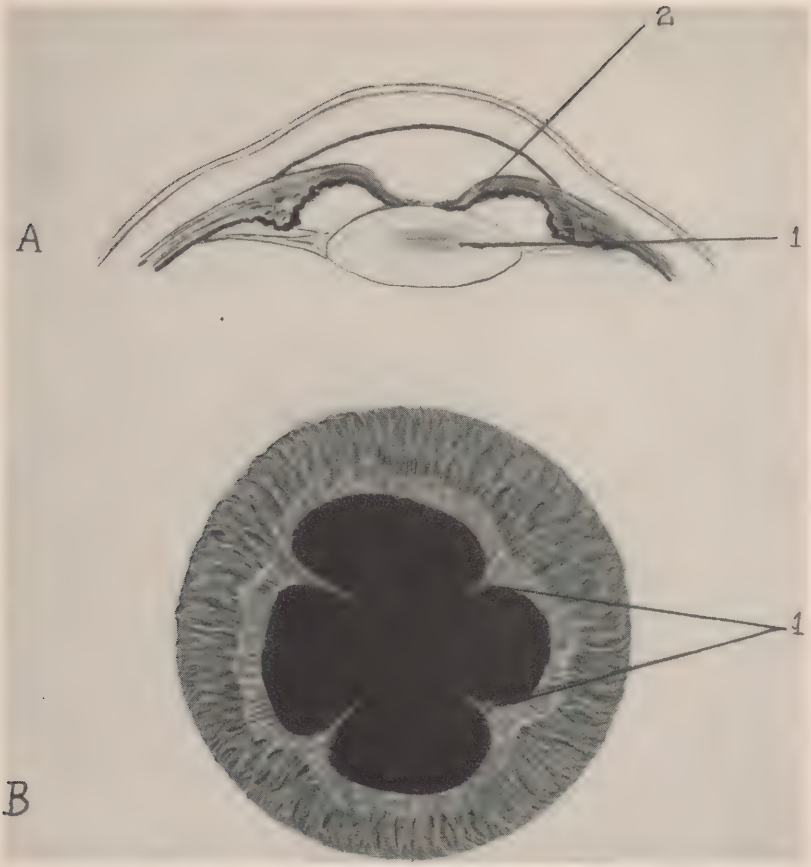


Fig. 9A – The end-result of iritis. 1 – lens covered by a dense white membrane which is opaque to light; 2 – iris bound down to lens along the entire pupillary and bulging forward due to increased pressure behind.

Fig. 9B – Iris was dilated with atropine. 1 – strands of iris tissue adherent to anterior surface of the lens (posterior synechiae).

the cornea or window of the eye may be the result of a serious general disease and an eye physician should be consulted.

Glaucoma. The name glaucoma is applied to a symptom present in many eye diseases, namely an increase in the pressure within the eyeball resulting in increased hardness of the eyeball (raised tension). The increased pressure in the eye is due to a decreased flow of the fluids out of the eyeball through the exit channels. The optic nerve in advanced glaucoma (Fig. 10) is deeply cupped. This is in marked contract to the normal optic disk as shown in figure 12, which lies on the same level

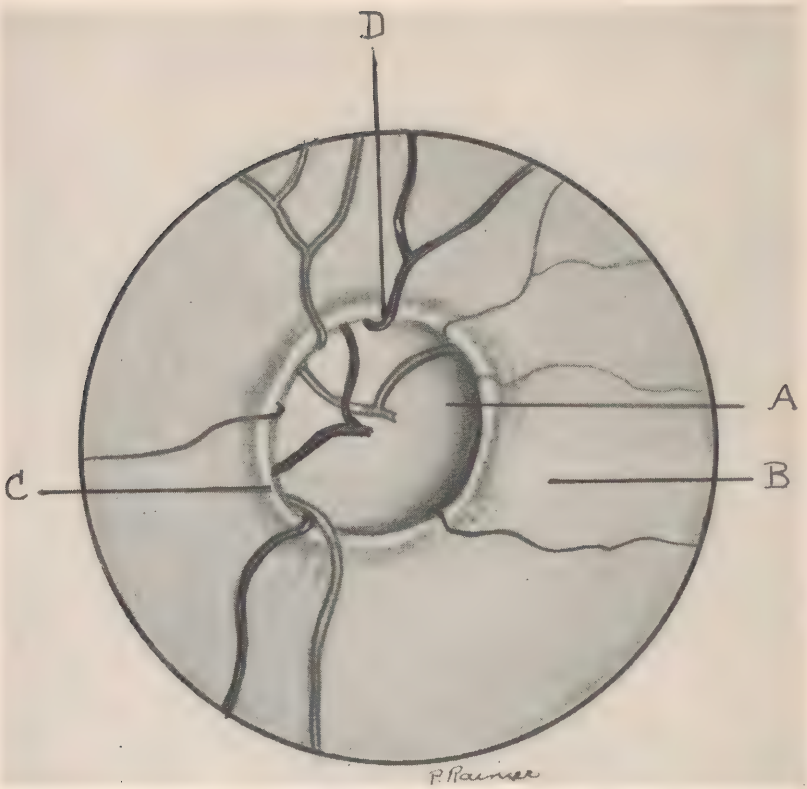


Fig. 10 – Optic disk in glaucoma (schematic). The drawing illustrates the cup-shaped depression of the disk: A – with reference to the rest of the fundus B – the sharp margin C – of the optic nerve projects into the lumen of the cup and the blood vessels D – bend sharply outward as they emerge from the cup.

as the rest of the fundus. The blood vessels in glaucoma are seen to cross over the edge and bend outward. This cupping may be produced partly by increased pressure in the eyeball, partly by inflammation, resulting in damage to, and disappearance of the fibers of the optic nerve (atrophy).

Glaucoma may occur in infants (congenital glaucoma). This is due to poor development or blocking of the outlet channels of the eye and occasionally to a prenatal inflammation. Since secretion continues in the eyeball, although the outflow is blocked, the pressure must rise, the coats of the eyeball stretch and the eye enlarges to the proportion of the so-called "ox-eye" (buphthalmos).

In the adult we encounter two varieties of glaucoma: (1) primary glaucoma, the cause of which is not definitely known, and (2) sec-

ondary glaucoma which has a definite cause and which is usually the result of an inflammation of the iris or choroid. There are two types of primary glaucoma: (a) the noncongestive type or glaucoma simplex and (b) congestive glaucoma. Primary glaucoma may also be divided into acute and chronic types. In acute glaucoma the eye becomes markedly inflamed and painful. Although we are ignorant of the cause in most instances, we believe that an intestinal or other focal infection often initiates an attack. An intense emotional disturbance may also be a precipitating cause. Chronic primary glaucoma constitutes the larger and hence the more important group. Frequently a patient will not consult an eye physician until he becomes aware that he bumps into objects or has difficulty in walking or driving. This is explained by the fact that he has lost side or peripheral vision, while his central vision may still be unimpaired. This is a late stage of the disease. It is important to detect glaucoma in its early stage when diagnosis is often difficult. In chronic primary glaucoma the eyeball may be hard over a long period of time without the patient being aware of it.

The old statement that "glaucoma is a sick eye in a sick body" is being better understood every day. Therefore, in every case of hardening of the eyeball we must look for general causes. There is the possibility of chronic infection acting on the thyroid and adrenal glands. It is often valuable to have a determination of the blood chemistry made. In any event, when we study these eye conditions carefully, we usually find some other causes which may be responsible for them. There may be, and usually are, nervous factors influencing these conditions. The encouraging fact about glaucoma is that we are increasingly studying it more from the psychologic, the chemical, the glandular and other general aspects.

The following suggestions should be helpful to patients who have glaucoma:

1. Put the drops prescribed by your eye doctor into your eyes regularly according to the schedule advised by the doctor.
2. Do not use belladonna (or atropine) in any form unless your eye doctor approves it.
3. Avoid alcohol, tobacco and excess in eating.
4. Keep your bowels in good condition.
5. Be sure that your teeth are healthy.
6. Have a thorough physical examination once a year.
7. Avoid emotional upsets as much as possible.
8. Return for re-examination when requested.

Retrobulbar Neuritis. This is an inflammation of that portion of the optic nerve which is situated behind the eyeball. The inflammation may be so severe that on looking into the eye with the ophthalmoscope, papilledema (swelling of the optic nerve head) is observed. In other cases diagnosis is difficult because the inflammation of the nerve, back of the eyeball, may be so mild that no change can be detected in the appearance of the head of the optic nerve, which is the only portion of the nerve accessible to visual examination. Patients who have retrobulbar neuritis commonly complain of poor vision one day and better vision the next, or they may have attacks of blurred vision lasting only a few moments. Retrobulbar neuritis is common in young people between 10 and 20 years of age.

Cataract. The lens is the magnifying glass of the eyeball. Normally, it is perfectly transparent. If it loses this transparency and becomes opaque, a cataract is present.

Recently it has been found that German measles occurring in the first three months of pregnancy has resulted in congenital cataract and other congenital abnormalities in the offspring.

A cataract may be present at birth, in which case it is known as a congenital cataract. It may take on various appearances, one of them being a lamellar cataract as shown in figure 11A. It is represented by a white opacity in the center of the pupil. This type of cataract, of course, is fully developed when it comes to the attention of the oculist. Since congenital cataract shows hereditary tendencies, it is unwise for such an individual to marry into a family where this condition has occurred. There are 5,408 pupils in the United States residential and day schools for the blind. Of this number 14.2 per cent are blind as a result of congenital cataract.

Another type of cataract is the incipient senile cataract (Fig. 11B) the type that develops in people past middle age. It is probable that age alone is not the most important factor in the production of the cataract.

We are beginning to realize that the patient's general condition plays an important part in the causation of cataract. Several years ago in a certain hospital in this city, every patient with a cataract was immediately operated upon. At present in most hospitals careful general studies, including Wassermann tests, urinalysis and blood chemistry are usually made before operation is advised.

For a long time we have been impressed with the close relation that exists between chronic infection and cataract. We are being forced to the conclusion that cataract has a cause, even if we are un-

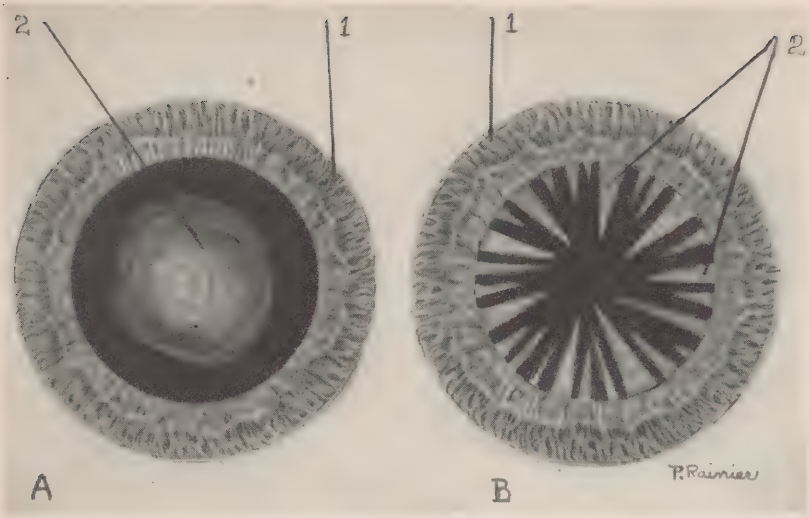


FIG. 11A – Lamellar cataract (congenital). 1 – iris; 2 – central cloudy (cataractous) portion of lens.

FIG. 11B – Incipient senile cataract. 1 – iris; 2 – spoke-like opacities in the outer layers of the lens.

able to find the cause. In the present state of our knowledge, we must make every effort to find that cause, whether it be in the nose, throat, sinuses, teeth, intestinal tract, blood or glandular system.

Finally a brief word on the treatment of cataract. Once the cataract has become established, it cannot be dissolved; it consists of degenerated lens fibers enclosed by the lens capsule. In the incipient stage we may see improvement under appropriate general treatment, but once the fibers are degenerated they will never return to normal.

Pathologic or Disease Changes in the Fundus (Or Interior of the Eyeball)

The normal background (fundus) of the eye is shown in figure 12. From the center of the papilla or optic disk (the spot where the nerve enters the eyeball) the veins and arteries branch out over the entire fundus of the eye. The normally pigmented fundus has an orange-brown-red appearance. In the exact center is the macula lutea or yellow spot and in the center of this is the fovea centralis, the point of most acute vision.

Progressive Myopia (Near-sightedness). This refractive error may become so severe that it results in damage to the retina and choroid

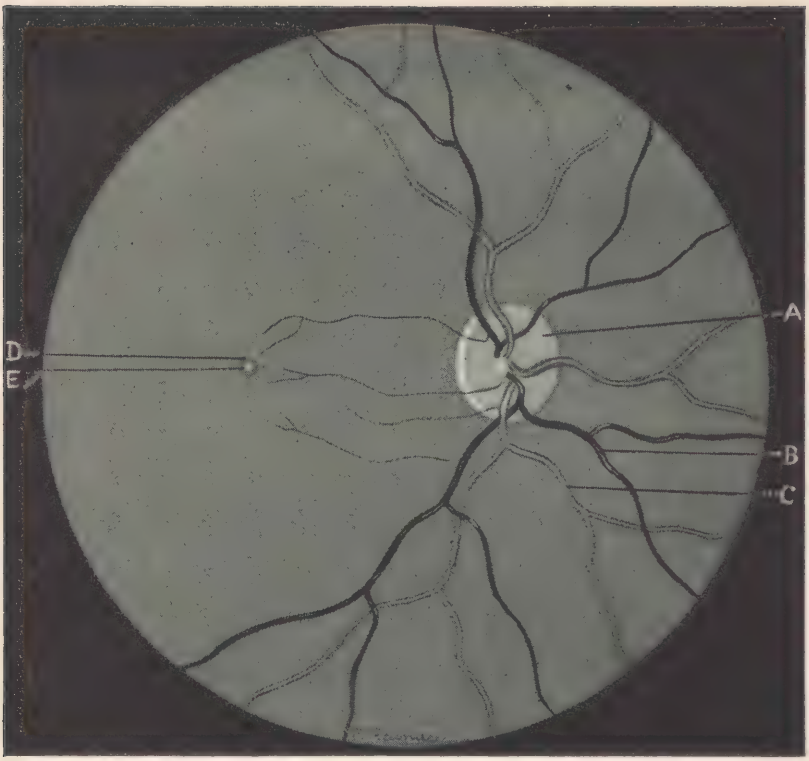


Fig. 12 – The normal background of the eye. A – optic disk; B – branch of vein; C – artery; D – macula lutea or yellow spot; E – fovea centralis.

through excessive stretching of the eyeball (see Fig. 13). Such cases of malignant myopia are fortunately rare and are encountered less frequently now that we are taking better care of the health of our children.

The usual type of myopia, while it is progressive, should not be regarded as a disease. Its progression is associated with the growth of the child and stops when the body ceases to grow.

Retinal Arteriosclerosis. One of the most important phases of the entire field of medicine is included under the heading of cardiovascular-renal disease, i.e., disease of the heart, the blood vessels and the kidneys. These three systems are usually classified together because whenever one system is diseased the others tend to be involved. While various classifications have been attempted, their value is limited. The chief fact to bear in mind is that we are sometimes able to detect disease of the heart, kidney and blood vessels by examining the retina with the ophthalmoscope.

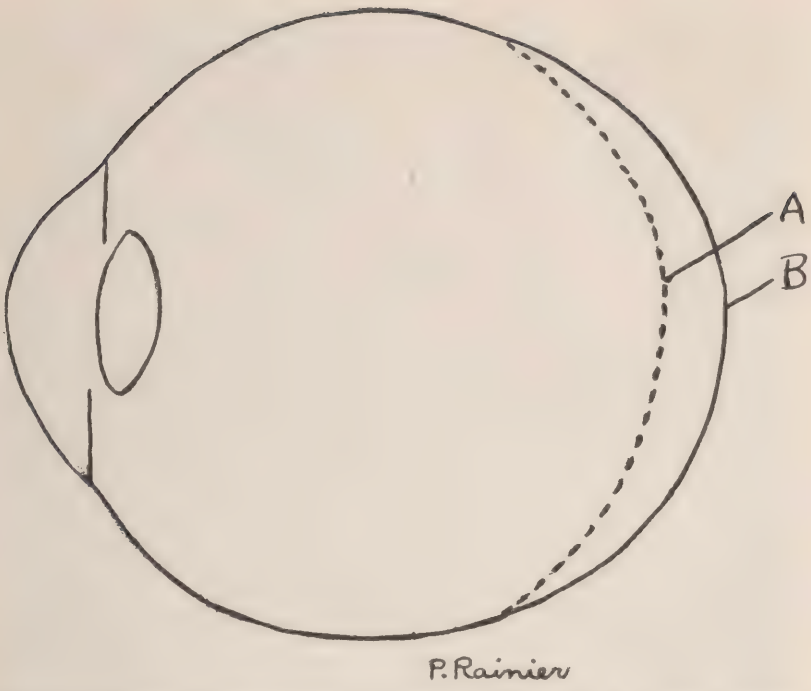


Fig. 13 – Schematic representation of progressive myopia. A – normal contour of eye; B – stretched contour of myopia eye.

Recently it has been shown that diet rich in cholestrol and other fatty substances is an important factor in producing arteriosclerosis. A low cholesterol and salt free diet, such as the rice diet, is an effective means of controlling this common systemic disorder.

The causes of arteriosclerosis are not definitely determined. Here again, a general study of the patient is most important. We studied 71 patients and of these only 14 had uncomplicated hardening of the arteries, while 47 were complicated by focal infection. (Ten submitted no medical report). This illustrates the importance of a general physical examination and suggests the need for consideration of focal infection.

Diabetic Retinopathy. Figure 14 shows the fundus of a patient suffering from diabetes. It illustrates well the hardening of the arteries, indentations of the veins, hemorrhages, and small whitish spots which are the end result of inflammation. A careful examination of the fundus gives important clues to the presence of certain systemic diseases. The exact diagnosis must of course be left for the physician to make.

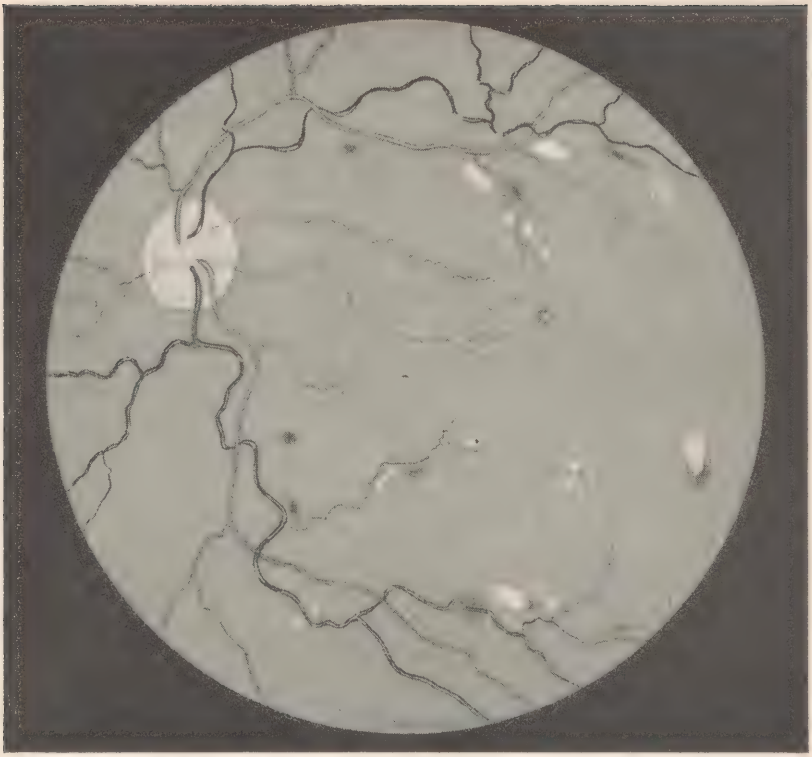


FIG. 14 — Fundus drawing of a patient with diabetic retinopathy. Note the grayish white deposits and atrophic areas; the advanced hardening of the arteries shown by the indentation of the veins by the arteries; the changes in the caliber of the vessels, and the narrowing of the light streak; the rounded deep and superficial flame-shaped hemorrhages.

Ocular Syphilis. This is a general infectious disease which is less frequent now than in years past. Hard chancre (the primary lesion) of the eyelids is very rare. The iris may be infected by syphilis in the secondary and tertiary stages.

The disease may also affect the tissue in the back of the eye. When it involves the seeing coat (the retina) it also invades the blood vessel coat (the choroid) thus resulting in chorioretinitis. In many cases syphilitic retinitis takes on a form which simulates retinitis pigmentosa (a progressive disease of the retina with pigmentation, the cause of which is unknown).

Fortunately syphilis is one of the diseases which can be controlled and sometimes even cured. In addition to the arsenicals which have been used for the last forty years, penicillin in large doses is now being successfully employed.

Ocular Tuberculosis. Tuberculosis of the eye forms an important chapter in the diseases of the eye. Tuberculosis is difficult to diagnose. The skin tests are likely to be positive in any healthy person over five years of age. Therefore, to make sure that the diagnosis is correct, it would be necessary to remove the eyeball and examine it. Yet, we feel that a markedly positive skin test, performed by injecting tuberculin into the skin, may be indicative of tuberculosis.

Acute miliary tuberculosis of the eye is usually seen only in the terminal stages of tuberculosis of the lungs, shortly before the patient dies. We see litle white areas, which are tubercles, scattered throughout the fundus.

Another type of this disease, commonly due to tuberculosis, is disseminated chorioretinitis, that is, scattered areas of inflammation affecting the choroid and retina. These patients, mostly children, should have the best possible general care, and they should not be permitted to strain their eyes.

Another type of tuberculosis affects the central part of the back of the eye and may destroy central vision. We also see nontuberculous inflammation of the back of the eye which looks more or less like tuberculosis, so that it is often hard to differentiate among these conditions.

Since it is difficult to determine with certainty whether or not one is dealing with tuberculosis in this type of inflammation in the back of the eye, it is generally conceded that it is most important to rule out all other causes before the inflammation can be diagnosed as tuberculous. Similar inflammations in the back of the eye may be caused by dental, sinus, tonsil or gallbladder infections.

Conclusion

In determining the causes of eye conditions we must take every possible factor into consideration. We are too likely to be enthusiastic about one theory. One physician may believe that the majority of eye diseases are due to tuberculosis, another may accuse the tonsils, another the teeth, a fourth the sinuses, but none of these should be considered to the exclusion of the others. The more we see of the practice of diseases of the eye the more we feel that one must make a very thorough and complete general examination of eye patients, and accompany local treatment of the eyes with the treatment of systemic conditions. Above all, one must consider the sociologic and the psychologic aspects of each individual case.

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